# Tutorials work for Alternating current chapter

## Exercise N°1

Express the following signals in the standard form, $A\ sin\ (wt + \theta)$.

a- $v_1\ (t) = 20\ cos\ wt$

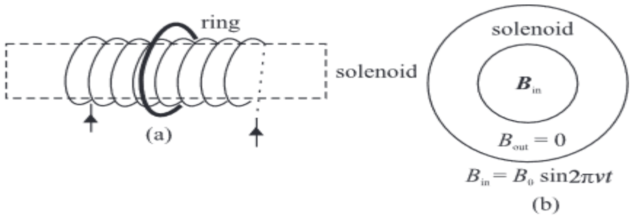
b- $v_2(t) = 100\ sin\ wt + 75\ cos\ wt$

c- $v_3\ (t) = 10\cos\left(wt - \frac{\pi}{2}\right)$

## Exercice N°2

1- The axis of a 75 turn circular coil of radius 35mm is parallel to a uniform magnetic field. The magnitude of the field changes at a constant rate from 25mT to 50 mT in 250 millisecond. Determine the magnitude of induced emf in the coil in this time interval.

2- Consider a long solenoid with a cross-sectional area 8cm2 (Fig.a and b). A time dependent current in its windings creates a magnetic field B(t) = B0 sin 2πvt. Here B0 is constant, equal to 1.2 T. and v, the frequency of the magnetic field, is 50 Hz. If the ring resistance R = 1.0Ω, calculate the emf and the current induced in a ring of radius r concentric with the axis of the solenoid.




## Exercice N° 3

A magnetic field $\vec{B}$ is directed outward perpendicular to the plane of a circular coil of radius $r$=0.50$m$. The field is cylindrically symmetrical with respect to the center of the coil, and its magnitude decays exponentially according to$B = 1{,}5.\,e^{(-5.0t)}$, where **B** is in teslas and **t** is in seconds.

3- Calculate the emf induced in the coil at the times $t_1$=0, $t_2$=5.0×10$^{-2}$$s$, and $t$3=1.0$s$.

4- Determine the current in the coil at these three times if its resistance is 10Ω.

## Exercise N° 4:

I)- Consider a sinusoidal voltage with rms value Ueff=15 V and period T=1 ms.

1- Calculate its maximum value, frequency and angular frequency.

2- Express the instantaneous voltage as a function of time. This voltage is 10 V at the initial instant.

3- Determine the complex amplitude of this voltage.

II)- Using the complex method, determine the sum of the three voltages defined by their RMS values and initial phases

$$\underline{U_1} = (55\,V, 90°) = 55\,V \,\underline{|90°}$$
$$\underline{U_2} = (75\,V, 45°) = 75\,V \,\underline{|45°}$$
$$\underline{U_3} = (100\,V, 0°) = 100\,V \,\underline{|0°}$$

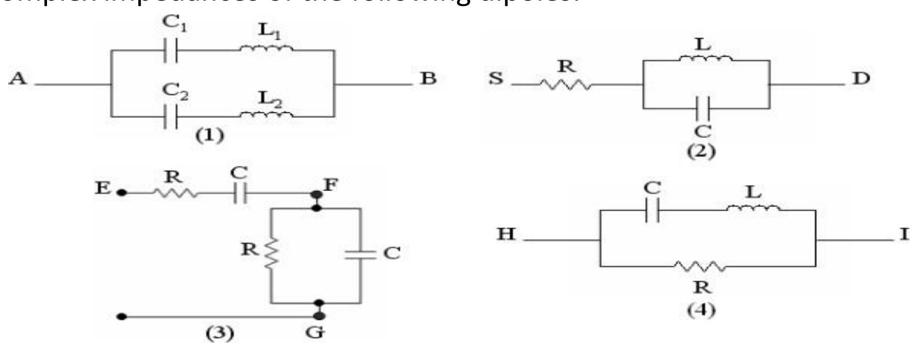
## Exercise N° 5

The instantaneous value of an alternating current is: $i(t) = 15.5A \sin(100\pi t - \pi/6)$

1. What is the Maximum value of the alternating current?
2. What is the RMS value of the current (effective value)?
3. What is the angular frequency? Deduce the value of the frequency and the period.
4. Calculate the value of the current at time t = 0, at time t = 5 ms and at time t = 10 ms.
5. This current is applied to a 20Ω resistor. Express the voltage u across this resistor.
6. Calculate the rms voltage.

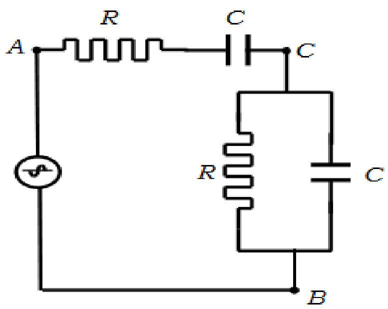
## Exercise N° 6

Determine the complex impedances of the following dipoles:




## Exercise N°7

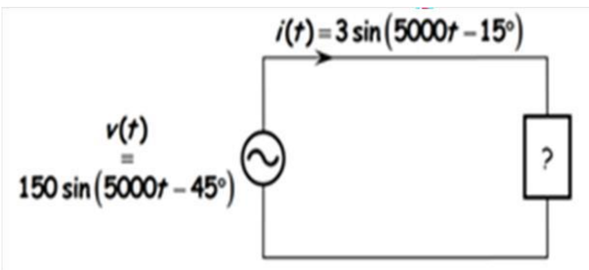
Determine the equivalent impedance ZAB of the circuit circuit supplied with voltage $u(t)$ and shown on figure.
We have:
A.N : R = 1 kΩ , C = 1 μF and f = 5 kHz




## Exercise N°8

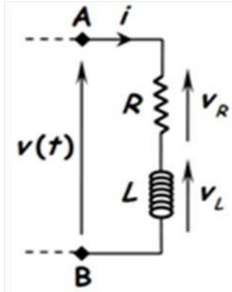
Let's consider the electric circuit shown in the following figure.

1. Express *v(t)* and *i(t)* in polar form.
2. Determine the impedance of the circuit.
3. Identify the elements of the circuit.



**Exercise N°9**

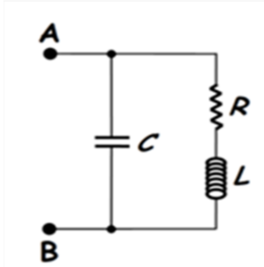
Let AB be the section of an electric circuit shown in the adjacent figure with: R=150 Ω , L=0.5 H, $v(t) = 33.9\ sin(100\pi t)$.




1. Calculate the impedance $Z_{AB}$ of the given section.
2. Calculate the phase shift φ imposed by this section of the circuit.
3. Calculate i, and then deduce $v_L$ and $v_R$.
4. Verify that $v(t) = v_L(t) + v_R(t)$

**Exercise N°10**

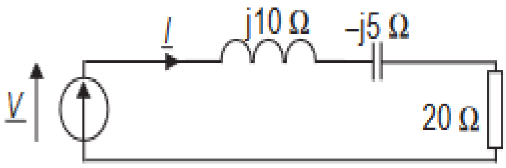
The adjacent dipole is powered by a sinusoidal voltage with ω=314 rad/s, C=1 µF, R=50 Ω and L=0.1 H.




1. Calculate the magnitude and argument of the admittance $Y_{AB}$.
2. Deduce the magnitude and argument of the impedance $Z_{AB}$.
3. Determine the element to place in parallel between terminals A and B so that the impedance $Z_{AB}$. (viewed between A and B) is purely real. What can be said, then, about the current and voltage of the dipole?

**Exercise N°11** Vector representation of currents and voltages

Consider the circuit shown in the following figure, where $\underline{V}$ is the complex representation of a sinusoidal voltage of rms value $V = 100\ V$ and frequency 50 Hz. The components of this circuit are directly characterized by the value of their complex impedance.




1) Calculate the rms value $I_{eff}$ of the current $\underline{I}$.

2) Calculate the phase of the current if we consider the voltage at the phase origin. Write the temporal expression of voltage v and current i.

3) Write the Loop law governing this circuit.

4) Represent all the complexes forming this loop law on a vector diagram in the complex plane (Fresnel diagram: phasor diagram).

**Exercise N°12**

Sketch the phasors for the following voltages on the same diagram and state for each pair the leading voltage and the angle of lead.

a- $v_A(t) = \sqrt{2}\,100 \sin(wt + 30^\circ) = \sqrt{2}\,100 \sin\left(wt + \frac{\pi}{6}\right)$

b- $v_B(t) = -\sqrt{2}\,120\ cos\ wt$

c- $v_C(t) = 200\ cos\ (wt + 60°)$

## Exercise N°13

Consider the circuit shown in the figure, subjected to a sinusoidal voltage $u(t) = U\ cos\ (\omega t)$.

We ask you to determine the currents $i_1(t) = I_1\ cos(wt + \varphi_1)$ , $i_2(t) = I_2\ cos(wt + \varphi_2)$ and $i(t)\ (t) = I\ cos(\omega t + \varphi)$.

1- Determine $i_1(t)$ using respectively:
   a- The complex method
   b- Fresnel construction.
2- Determine $i_2(t)$ using the complex method. Is $i_2$ in phase advance (leading) or lagging relative to $i_1(t)$?
3- What relationship must L, C and w satisfy for $i_2(t)$to be in phase with $u(t)$? Reduce the corresponding frequency.